SELECTED

WATER

RESOURCES

ABSTRACTS

Selected Water Resources Abstracts includes abstracts of current monographs, journal articles, translations, and reports. The contents of these documents cover the physical, life, and social science, as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water.

It is one of several products which will be provided by WRSIC for scientists, engineers, and managers in water resources to satisfy their current awareness needs.

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Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

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SELECTED
WATER RESOURCES ABSTRACTS

VOLUME 1, NUMBER 3

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TABLE OF TITLES

TABLE OF TITLES--Continued

Flow charts can be helpful when planning and developing new procedures, preparing computer programs, eliminating work duplication, training new employees, and pinpointing weaknesses in existing procedures. The 2 types of charts are the general flow chart, indicating highlights of the overall operation and the detailed flow chart, showing all tasks necessary to describe the entire operation. Four key rules to observe when preparing a flow chart are: (1) maintain simplicity, (2) avoid sentences and para- graphs, (3) ensure easy readability, and (4) use standard symbols. Flow chart symbols illustrating standard shapes to be used when graphically referencing a particular function are included. Different types of equip- ment available for constructing flow charts include flannel boards with precut symbols; metal boards with magnetized symbols; pasteup symbols and flow lines; and pencil, paper, and a template containing the standard symbol cutouts. Flow charts may be used in many ways by different depart- ments. Perhaps their most common uses are pinpointing responsibilities and presenting general outlines of departmental activities.

R202581X67A PUTTING ILLUSTRATIONS TO WORK

To succeed in the environment of contemporary technology, engineers must be able to formulate their technical thinking (ideas, data, and know-how) within the disciplines imposed by conventional technical reports. The design of illustrations for such papers is a discrete tool to be mastered as part of the requirements of the profession. The 4 purposes of illus- trations are correctness, accuracy, emphasis, and ease of comprehension. For each type of technical illustration (tables, figures, and equations), detailed instructions and examples are given to assist the report writer in achieving these purposes. The term figure includes drawings, sketches, photographs, maps, graphs, histograms, bar charts, pie diagrams, flow diagrams, and balance sheets. They all should have specific but simple titles, be related to the text by number and placed near the reference in the text or, if referred to repeatedly, attached as a foldout to the last page. Equations are valuable for neatly summarizing large amounts of tabulated or plotted data, sometimes suggesting useful applications or extension of the data. Tables are perhaps the most useful method of presenting data in that they give exact numerical values and are not limited by the number of variables.

R202593X67A   NEW THINKING IN APPRAISAL THEORY

Real estate appraising is still appropriately described as an art rather
than a science. The author contends that it will remain so as long as the
fundamental theoretical structure on which practice is based is outmoded,
excessively abstracted reality. In the past 5 yr, significantly broadened
interest in real estate evaluation has developed among academic students of
economics and finance. The stimulating writings of Dr. Richard Ratcliff of
the U of Wisconsin have done much to provoke this interest; his concepts
and those of the author are reviewed. Concepts that can be put into prac-
tice now without controversy are general annuity capitalization, discounted
cash flow analysis, property residuals with shorter term projections, anal-
ysis in terms of tax structures and investor characteristics, applications
of electronic data processing to market data analysis, and critical path
programming. Other concepts require further testing through research and
case studies before they can be added to the operational tools of the prac-
ticing appraiser; these include market simulation, probability analysis,
benefit-cost analysis, cost of capital studies, most probable use, and most
probable selling price. This research should result in appraisal theory
that is more realistic, more descriptive of real estate market activity,
and more defensible.

R202608X67A   NEW CONTROLS HELP INSURE QUALITY

Quality control (QC), a management tool to insure that only the highest
quality work is produced, has proved as effective for office as for pro-
duction work. QC enters the office through work measurement systems such
as Master Clerical Data (MCD) or through approaches such as Zero Defects.
QC departments developing in big organizations have 3 responsibilities:
(1) prevention or quality planning in the design stage to check for all
potential causes of failure, (2) appraisal or verification that the product
delivered conforms to specifications and preparation of test and inspection
data, and (3) analysis of the causes for failure and action to remove them.
A QC tenet is that errors are not inevitable; efforts should be directed
toward doing the job right the first time. Excessive inspection of staff
office work decreases quality, but a system like MCD, based on a catalog of
time values, study of each worker's capabilities, job audits, and inter-
views with workers, enables the administrator to adjust personnel to meet
varying needs and raise quality as well as quantity. Since human attitudes
are very important, personnel must understand the reasons for QC as well as
the methods. Specific examples using MCD and other systems are cited.

R202632X67A HOW EXECUTIVES WILL MAKE DECISIONS

A long-range study on top management conducted by Yale University defined
the decision-making patterns that will help future executives cope with the
computer age and information explosion. By studying successful and unsuc-
cessful practices in top management today, the best methods for tomorrow
become clear. The one-man operation of the directive, controlling execu-
tive is obsolete now that all the information and skills available are
needed for effective administration. Future organizations will depend
less on coercive power and more on the competence of a strong management
team. The matrix organization will exist along established lines for
routine work, but special teams chosen across organizational lines for
applicable skills will provide management with the information needed for
sound solutions to planning, innovating, risk-taking, or trouble-shooting
problems. These teams will receive in-service training that focuses on in-
dividuals in team systems, uses actual problems, can be tested by the ef-
fectiveness of results, and is controlled by the participants. Future
executives, instead of stamping out intergroup conflict, must learn to
manage it so that constructive elements are emphasized. Effective manage-
ment must define internal environments that challenge people, stretch
their aspirations realistically, and help them face interpersonal reality.

<div align="right">R202632X67A</div>

Argyris, Chris
HOW TOMORROW'S EXECUTIVES WILL MAKE DECISIONS
Think, Vol 33, No 6, pp 18-23, Nov-Dec 1967. Yale U, New Haven, Conn, 6 p
DESCRIPTORS-- *decision making/ management/ information retrieval/
*organizations/ technology/ research and development/ organization charts/
responsibilities/ reasoning/ supervision/ *policy matters/ leadership/
human behavior/ employee relations/ *conferences/ efficiencies/ computers/
environment/ education/ universities/ motivation/ committees/ behavior
(psychology)
IDENTIFIERS-- interviews/ management engineering/ *executives/ problem
solving/ management planning/ risk/ ability/ human relations/ group
dynamics/ cooperation

R202562 67A   GLEN CANYON DAM DEFORMATION MEASUREMENTS

Deformation measurements were made on Glen Canyon Dam over a period of 3
yr. The deformation was caused by seasonal temperature variations, long-
term gradual warming of concrete, and loading imposed by impounded reser-
voir water. Two measurement systems were used: first-order triangulation
surveys and plumbline measurements. The measurement systems, field pro-
grams, apparatus, observation practices, and procedures adopted to increase
efficiency and accuracy are described; representative results are given.
Each year, the top of the dam moves about one-half in. during a 60-deg
temperature range. The total deformation from the initial measurements to
the maximum temperature period in 1966 was about 1-1/2 in. upstream.
Surveying methods offer a convenient and reasonably accurate means for
measuring dam deformation. More than 1 baseline is recommended in a
behavior triangulation net. The time-consuming procedure of turning angles
for precise triangulation could be supplemented by using presently avail-
able electronic distance measuring devices to reduce the cost and time
involved. With these devices, all measured lengths in the control net
would be comparable to computed baselines. Experiences indicate dam
measurements should be initiated during either the high- or low-temperature
period.

<div align="right">R202562 67A</div>

Richardson, Joe T
MEASURED DEFORMATION BEHAVIOR OF GLEN CANYON DAM
Paper, ASCE Ann Mgt & Water Resrcs Conf, New York, N Y, Oct 1967. Bureau
of Reclamation, Denver, Colo, 38 p, 15 fig, 3 tab, 6 ref
DESCRIPTORS-- *deformation/ *concrete dams/ movements/ *triangulation nets/
survey stations/ *surveying/ surveying instruments/ theodolites/ *thermal
expansion/ plumblines/ temperature/ mass concrete/ arch dams/ baselines/
structural behavior/ first order surveys/ field investigations/ measurement
IDENTIFIERS-- Glen Canyon Dam/ dam stability

R202586X67A KAINJI DEVELOPMENT

The 960-mw Kainji station will be the first of 3 hydroelectric developments
aggregating 1940 mw planned to serve the electrical network of Nigeria.
The initial installation at Kainji is 320 mw and is planned to furnish the
first power in 1968. Kainji Project was designed as the first stage of a
multipurpose development. The powerhouse at Kainji initially will contain
4 80-mw generating units, but provision has been made to increase the
installation to 12 units totaling 960 mw. The dam will provide numerous
benefits in addition to power supply. Two navigation locks and an inter-
mediate basin are being constructed, which, together with other river works
will permit navigation from upstream of Kainji to the sea. Regulation of
the flow of the Niger below the dam will extend the shipping season and
reduce flooding. A fishery industry is planned at Kainji Reservoir to
produce over 10,000 tons of fish per annum. At Kainji Dam a new road
crossing the river will provide a much needed alternative to the single-
track railway and road bridge at Jebba. A 330-kv government transmission
grid eventually will extend across southern Nigeria and as far north as
Kano.

R202586X67A

R202601 67A COMPRESSION SEALS IN BRIDGES

A foreseeable trend toward longer-span bridges, together with the realiza-
tion that a definite causal relationship exists between certain identifi-
able types of premature bridge distress and ineffective sealing practices,
has led to the development of interesting new sealing systems using the
compression principle. A photographic study of premature bridge distress
was made to understand better the causes of distress and what can be done
to minimize the problem. Design engineers should be able to identify,
describe, and predict magnitude of each of the types of movement that
might occur at the joint interfaces, and performance criteria are estab-
lished to assist in selecting an effective sealing system. Typical
sources and categories of movement phenomena on bridges are described and
their importance is emphasized in long-span joint sealing practice. Ex-
amples of current sealing systems and solutions in the U S and Europe are
illustrated and discussed in terms of performance capabilities.

R202601 67A

Corrosion resistance of steel in portland cement concrete results from a
passivating film of gamma ferric oxide. The film is formed and maintained
in an alkaline environment produced by cement hydration; however, high
concentrations of chloride or bisulfide will cause corrosion if air bub-
bles form on the steel surface. Laboratory tests were conducted to study
corrosion of bare steel rods in environments simulating porous concrete
contaminated with chlorides. Results show that the initiation of corrosion
requires free oxygen at the steel surface and a ratio of chloride to
hydroxyl ion activity of at least 0.6. A probability model is used to
explain the chloride effect and predict the threshold value causing
corrosion.

R202604X67A BOND & SLIP OF DEFORMED BARS IN CONCRETE

The action of bonding forces and associated slip and cracking are examined
for bars with various surface properties. Bond of deformed bars is devel-
oped mainly by the bearing pressure of the bar ribs against the concrete.
Bars having ribs with steep face angles (larger than about 40 deg with the
bar axis) slip mainly by compressing and crushing the concrete in front of
the bar rib. Bars with flat ribs slip with the ribs sliding relative to
the concrete. Experimental test results are presented to support these
conclusions. The stresses and deformations in the concrete caused by bond-
ing forces are discussed. Comparison of ACI Building Code bond and shear
equations with bond tests shows that shear provisions rather than bond
limitations usually will control the design.

R202563X67A SELECTION OF DRILLING METHODS

Production drilling methods for open-pit mining are reviewed. Selecting
a particular drilling machine requires value judgements and is the most
critical drill evaluation the pit engineer is required to make; determining
drillability factors, selecting a feasible method, and estimating perform-
ance parameters are the most difficult steps in the entire design proce-
dure. Percussion drilling, rotary drilling, and jet-piercing methods are
discussed. A table indicating applicability of various drilling methods
for different rock types is included, and a comparison is made of drilling
costs per foot for a 9-in. hole.

R202563X67A

R202564X67A EXCAVATION AND LOADING

Present-day functioning, performance, and operating efficiency of exca-
vating and loading equipment in the mining industry are reviewed. Strip-
ping and quarry-mine shovels, draglines, front-end loaders, and bucket
line and hydraulic dredges are discussed, along with power systems, dip-
per selection, bucket capacity, cycle times, and production rates and
costs. Several examples illustrating use of the equipment are given.

R202564X67A

Rock fragmentation mechanisms by blasting include slabbing, radial frac-
turing, crushing, and bursting by the gas bubble. Slabbing depends on
the magnitude and shape of the blasting shock wave and tensile strength
of the rock. Further fragmentation depends on the amount and energy of
gas in the bubble. Blasting rounds are designed from cratering curves
relating breaking parameters to explosive energy. Optimum depths from
single-charge cratering curves are adjusted for shot geometry in multiple-
hole blasting. A large assortment of explosives is available for differ-
ent blasting requirements; oxygen-balanced explosives, ammonium nitrate
blasting agents, metallized explosives, and nuclear explosives are
discussed. The design of blasting rounds is presented and the roles of
burden, stemming, and subdrilling are explained. Nuclear cratering
methods are included, and airblast and ground vibration problems examined.

R202565X67A

R202566X67A HAULAGE METHODS

Railroad, truck, conveyor belt, and hydraulic transport methods are
reviewed. The shovel-train system is unexcelled for handling rough rock;
the ideal application is in a large but not too deep open-pit mine with
transportation distances of over 3 mi. Railroad track location, grades,
rolling stock, and track control systems are discussed. Rear dump and
tractor-trailer dump trucks are compared and criteria given for evaluating
performance. Recent developments in truck powerplants, power transmission,
tires, tire treads, and truck bodies are summarized. Several types of belt
conveyor constructions have been developed to meet specific conveyor appli-
cations; frequently, the components of several types can be adapted to meet
a specific application. Prefabricated components; conveyor design; and
cable, wire-rope, shiftable, and declined conveyors are discussed. Advan-
tages of hydraulic pipeline transportation are examined briefly. Pilot
testing must be performed to accurately design the pipeline and pumping
equipment, because each slurry is unique and flow characteristics are
different.

R202566X67A

CONSTRUCTION

R202614X67A PILE-DRIVING FORMULAS FOR FRICTION PILES

Seven different pile-driving formulas were used to calculate the capaci-
ties of 93 timber, precast concrete, and steel piles for which field load
test data were available. The relationship between the computed and
measured capacities was analyzed using the reduced major-axis form of
linear regression analysis. Accuracy of the formulas varied with pile
type. The Gates, Janbu, and Danish formulas yielded the highest correla-
tion coefficients, followed closely by the Pacific Coast Uniform Building
Code and Hiley formulas. Capacities calculated using the Gow and
Engineering News formulas correlated poorly with measured capacities. A
statistical adjustment was applied to the formulas to bring them into con-
formance with the field measurements. Adjusted forms of the Gates, Janbu,
and Danish formulas were equally accurate and appeared satisfactory for
general use, but the Gates formula was simplest to use. Has 16 references.

R202614X67A

Olson, Roy E and Flaate, Kaare S
PILE-DRIVING FORMULAS FOR FRICTION PILES IN SAND
ASCE Proc, Jour Soil Mech & Fdns, Vol 93, No SM6, Paper 5604, pp 279-296,
Nov 1967. U of Illinois, Urbana; Norwegian Road Res Lab, Oslo, 18 p, 8
fig, 3 tab, 16 ref, append
DESCRIPTORS-- *piles/ *pile driving/ *friction piles/ sands/ *wood piles/
loads/ precast concrete/ steel/ cohesive soils/ field tests/ soil
mechanics/ *bearing capacities/ construction/ bibliographies
IDENTIFIERS-- formulas/ correlation/ sandy loams/ loading tests/ *concrete
piles/ *pile-driving formulas/ comparative studies/ *steel piles

DAMS AND HYDRAULIC STRUCTURES

R202607X67A RESPONSE OF EARTH DAMS TO EARTHQUAKES

Principal factors controlling the dynamic response of earth dams are sum-
marized, and time history and distribution of the accelerations produced
by an earthquake are discussed. Acceleration records obtained near the
epicenter of strong earthquakes are examined to determine the nature of
ground movements. In spite of their irregularity, these records are ame-
nable to analysis and the results are extremely useful in understanding
strong ground movements. Using these acceleration records, response of
typical dam sections is studied and time history and distribution of seis-
mic acceleration in the body of these structures are computed. A number of
such records show that: (1) maximum accelerations in dams follow a consist-
ent distribution which may be used in a stability analysis and (2) actual
time history of these accelerations can be incorporated in a stability
analysis. During strong ground movements, the upper part of an earth dam
near the crest is the most vulnerable point. Has 47 references.

R202607X67A

Ambraseys, N N and Sarma, S K
THE RESPONSE OF EARTH DAMS TO STRONG EARTHQUAKES
Geotechnique, Vol 17, No 3, pp 181-213, Sept 1967. U of London, G B, 34 p,
34 fig, 3 tab, 47 ref, 6 append
DESCRIPTORS-- *earthquakes/ *earth dams/ *seismic design/ sliding/
stability analysis/ seismic investigations/ bibliographies/ accelerating//
failure /mechanics// displacements/ foreign design practices// faults
/geology// soil mechanics/ dam design/ stress relieving
IDENTIFIERS-- *earthquake engineering/ *earthquake loads/ earth slides/
seismic stability/ *seismic studies/ effect/ Great Britain

R202630X67A PRESSURES ON DAMS DURING EARTHQUAKES

Intensity, distribution, and frequency characteristics of hydrodynamic
pressures acting on dams during earthquakes are discussed. A short review
of previous work on this subject is presented, with particular emphasis on
evaluation of common simplifying assumptions. Including compressibility of
water, an analysis is made of the pressures generated on a rigid dam with a
vertical upstream face; these results are intended for gravity dams. Gen-
eral expressions for the complete time history of pressures during arbi-
trary horizontal and vertical ground motions are derived. Ground acceler-
ation data recorded during the 1940 El Centro earthquake were applied to 3
reservoir depths to study the hydrodynamic response to the earthquake.
Conclusions were: (1) the concept of an added mass moving with the dam to
represent hydrodynamic effects is not valid for earthquake-type excita-
tions and (2) significant errors are introduced by ignoring compressibil-
ity of water. Standard design practice, in considering additional water
pressures on dams caused by earthquakes, is compared with the theoretical
responses. Has 21 references.

R202630X67A

Chopra, Anil K
HYDRODYNAMIC PRESSURES ON DAMS DURING EARTHQUAKES
ASCE Proc, Jour Engg Mech, Vol 93, No EM6, Paper 5695, pp 205-223, Dec
1967. U of California, Berkeley, 19 p, 6 fig, 1 tab, 21 ref, 2 append
DESCRIPTORS-- *dams/ *earthquakes/ *hydrodynamics/ gravity dams/ vertical
loads/ accelerating/ lateral forces/ mathematical analysis/ wave action/
design standards/ errors/ water pressures/ bibliographies/ vibrations/
*seismic design/ structural behavior/ *dam design
IDENTIFIERS-- *hydrodynamic pressures/ earthquake engineering/ earthquake
loads/ dynamic response/ dynamic loads

R202606X67A SEEPAGE STUDY USING MODELS

Studies for overcoming effects of capillary rise in a seepage model with a
free surface and the porous medium of sand pretreated with a water-
repellent silicone are described. The method of pretreatment is given, and
its effect on capillarity and permeability is considered. Use of an elec-
trical probe to locate water surfaces and any associated zones of partial
saturation in capillarity and model seepage tests is described. Another
technique determines hydraulic potential by electrical analogy applied di-
rectly to the model, using the percolating water as an electrolyte. Two-
dimensional seepage tests employing these various techniques were performed
on 4 types of models: an earth dam, an idealized dam with a parabolic up-
stream face, a vertical wall, and a uniform open channel. Accuracy with
which the free surfaces (and in 1 case, seepage surface) are simulated by
the models is assessed. Hydraulic potentials found by direct observation,
electrical analogy applied to the model, and calculation are compared.
Comparison is made between calculated and measured rates of flow. Exten-
sion of these techniques to the study of unsteady 3-dimensional flow with a
free boundary through anisotropic soil of composite section is discussed.

R202606X67A

Dixon, R K
NEW TECHNIQUES FOR STUDYING SEEPAGE PROBLEMS USING MODELS
Geotechnique, Vol 17, No 3, pp 236-250, Sept 1967. King's College, London,
G B, 19 p, 14 fig, 9 ref, 2 append
DESCRIPTORS-- *capillarity/ *seepage/ porous materials/ *hydraulic models/
sands/ *models/ electric analogs/ three-dimensional/ simulation/ silicones/
*phreatic line/ electrodes/ two-dimensional/ foreign design practices/
permeability/ dams/ earth dams
IDENTIFIERS-- free surface/ flow patterns// probes /instruments// Great
Britain

R202567X67A MONITORING TRANSFORMERS FOR FAULT GASES

Gases formed by decomposition of transformer oil when faults occur in the
core and coil assembly of an oil-filled transformer are collected in a
Buchholz relay. Many years of research on gases collected in relay
chambers, as a result of such faults, are reported. The liberation
mechanism of gas bubbles in oil is described and composition of the
intercepted gases is compared with the causes of gas formation. Gases
forming in a transformer often are either not detected by the Buchholz
relay or are detected only after a very long time. A technique enabling
any generation of gas to be detected at an early stage is described; oil
samples are taken from the transformer and the dissolved gases formed by
decomposition of insulating material are extracted and analyzed. The
method has been used chiefly for monitoring ehv transformers and reactors.

<div align="right">R202567X67A</div>

Dornenburg, E and Gerber, O E
ANALYSIS OF DISSOLVED AND FREE GASES FOR MONITORING PERFORMANCE OF OIL-
FILLED TRANSFORMERS. Brown Boveri Rev, Vol 54, No 2/3, pp 104-111, 1967.
8 p, 6 fig, 1 ref
DESCRIPTORS-- *power transformers/ oils/ *gases/ electric insulation/ extra
high voltage// *faults /electrical// decomposition/ chromatography/ carbon
monoxide/ electric relays/ carbon dioxide/ *transformer oils/ chemical
analysis
IDENTIFIERS-- *insulating oil/ insulation/ spectrometry/ argon/ *dissolved
gases/ Buchholz relay/ Switzerland/ foreign research

R202570X67A HEATING OF IRON NEAR HEAVY-CURRENT BUSES

The temperature of iron or steel near heavy-current buses often can rise
considerably because of eddy-current and hysteresis losses in the metal.
Exact calculation of this temperature rise is extremely difficult because
various influences can produce wide discrepancies in results. Formulas
and curves are derived enabling the limits of temperature rise to be
predicted approximately for the most important cases occurring in practical
installations. Results of calculations were checked with measurements, and
close agreement was obtained. Examples of calculations for single- and
3-phase installations are given.

<div align="right">R202570X67A</div>

Kluge, P and Schaffer, G
THE HEATING OF IRON NEAR HEAVY-CURRENT BUSBARS
Brown Boveri Rev, Vol 54, No 2/3, pp 122-131, 1967. 10 p, 15 fig, 1 tab,
6 ref
DESCRIPTORS-- *heating/ *electric currents/ alternating currents/ *steel/
magnetic fields/ magnetic induction/ hysteresis/ temperature/ calculations/
losses/ electrical resistivity// *bus /electrical// thermal conductivity/
electricity/ electrical engineering/ electric fields/ electric potential/
electrical equipment/ electrical conductance/ hydroelectric powerplants
IDENTIFIERS-- *eddy currents/ *induced currents/ *flux density/ foreign
research/ Switzerland/ electric conductors

R202578X67A BRAKING VERTICAL HYDROGENERATORS

Gate leakage torque of hydraulic turbines must be considered in generator
brake design; however specifications requiring braking systems for turbine
gate leakage not exceeding an amount producing 1 or 2% rated generator
torque are not practical. Such specifications assume nonexistent condi-
tions and increase generator cost and maintenance. A more realistic ap-
proach should be used, omitting any reference to gate leakage torque from
specifications. The relationship of generator friction and windage torques
and gate leakage torques of 1 or 2% of generator-rated torque is shown
graphically. Possibilities of developing more realistic specifications for
generator braking systems are explored.

R202578X67A

Roth, H H
BRAKING VERTICAL HYDROGENERATORS
Allis-Chalmers Engg Rev, Vol 32, No 3, pp 7-8, 1967. 2 p, 2 fig, 1 photo
DESCRIPTORS-- *hydraulic turbines/ torque/ *electric generators/ design/
*specifications/ hydroelectric power/ deceleration/ *brakes/ velocity/
kinetic energy/ costs/ maintenance/ leakage/ gates/ losses
IDENTIFIERS-- wicket gates/ electric machinery

R202579X67A GENERATOR STABILITY AND STATIC EXCITATION

Stability in a power system is capability to restore equilibrium in the
event of sudden load disturbances. Static excitation can assist hydro-
oriented power systems to maintain transient stability. A series of field
tests and computer studies recently completed on hydroelectric systems with
long transmission ties shows the need for an ideal excitation system for
synchronous generators, i.e., one with a zero time constant or no time lag.
A new static (thyristor) excitation system having the ability to reach
ceiling voltage quickly at the moment a system fault occurs is discussed.
Benefits of static excitation systems are given.

R202579X67A

Van Vranken, W P
IMPROVING HYDROGENERATOR STABILITY WITH STATIC EXCITATION
Allis-Chalmers Engg Rev, Vol 32, No 3, pp 20-22, 1967. 3 p, 5 fig, 1
photo
DESCRIPTORS-- *excitation/ *electrical stability/ *electric generators/
hydroelectric powerplants/ disturbances/ loads/ electronic equipment/
electrical engineering// transmission /electrical// *voltage regulators/
electronics// faults /electrical// field tests/ power factors
IDENTIFIERS-- *static excitation/ thyristors/ electric machinery

R202580X67A CONTROLLING TRANSFORMER OIL QUALITY

Transformer performance is dependent on steps taken to assure consistent
oil quality. Because oil provides heat transfer and insulation to all
interior parts of oil-filled transformers, manufacturers and users must
maintain rigid quality control of the oil. Preparation of an adequate
purchase specification and selection of approved suppliers are necessary
first steps, but day-to-day control measures (vendor continuity control,
receiving inspection, and in-plant process control) ensure continuous high
quality of oil received and used.

R202580X67A

Shombert, George, Jr
CONTROLLING TRANSFORMER OIL QUALITY
Allis-Chalmers Engg Rev, Vol 32, No 3, pp 29-31, 1967. 3 p, 1 fig, 1
photo, 8 ref
DESCRIPTORS-- *transformer oils/ *quality control/ contamination/ colors/
heat transfer/ electric insulation/ *inspection/ sampling/ viscosity/ test
procedures/ oxidation/ control/ specifications/ specific gravity/ moisture
content/ acceptance tests/ electrical resistivity/ test specimens/ test
facilities/ dielectrics/ odors
IDENTIFIERS-- *insulating oil/ test results/ dielectric properties

R202583X67A COMPROMISE AIDS ARRESTER SELECTION

Compromise between current limitation and energy dissipation aids in
choosing station arresters for protective performance during switching
surges. Arrester designs and applications usually are governed by energy
dissipation resulting from switching surges. Current-limiting gaps can
reduce the switching duty, but trade-offs between current limitations and
energy dissipation are involved and present problems. Such trade-offs are
discussed to clarify the relationships, and calculations are presented to
assist in interpreting oscillograms of switching surge tests on current-
limiting arresters. Two simple circuits are used to illustrate the criti-
cal nature of arrester-circuit interaction.

R202583X67A

Sakshaug, E C and Heaman, D E
TRADE-OFFS DEVELOPED FOR ARRESTER SELECTION
Elec World, Vol 168, No 19, pp 25-53, Nov 6, 1967. Gen Elec Co,
Schenectady, N Y, 4 p, 6 fig, 1 tab
DESCRIPTORS-- *lightning/ *energy dissipation/ electric currents/ circuits/
calculations/ electric potential/ analysis/ electrical networks/ electrical
impedance/ electric insulation/ electrical engineering/ electrical
equipment// transmission /electrical// alternating currents// substations
/electrical// switchyards /electrical// surges
IDENTIFIERS-- *lightning arresters/ *switching surges/ flashover//
protection /electrical// spark gaps

R202598X67A CALCULATING D-C CABLE INSULATION STRESSES

High-voltage d-c transmission is becoming increasingly important where
heavy loads are transmitted over long distances. While most hvdc
transmission will be overhead, a certain amount of insulated cable will
be used for underground, submarine, and indoor work. Electrical stresses
in the insulation of such cables are important if safe and economical
designs are to be developed. Because stress distribution under direct
voltage is governed primarily by resistivity, which varies greatly with
temperature, it is more difficult to calculate than the corresponding a-c
stress distribution. A technique, based on a numerical approach, is
presented for calculating stress distribution. This technique permits
easy computation of d-c stress distribution. Charts illustrating measured
relationships between stress, temperature, and resistivity are given. In
cases studied, the maximum d-c stress is decidedly lower than the maximum
a-c stress for a given voltage and cable construction. Has 20 references.

R202599X67A EXTRA-HIGH-VOLTAGE D-C INSULATOR TESTS

Laboratory tests were conducted by the Bonneville Power Administration
(BPA) to determine d-c flashover characteristics of clean and artificially
and naturally contaminated transmission line suspension insulators.
Direct-current flashover of clean and contaminated insulators in the fog
chamber was found to be a linear function of string length up to 350 kv.
Comparative data are presented on a number of specimens for clean-wet and
contaminated insulators in the fog chamber. BPA's fog chamber tests on
artificially contaminated insulators are equivalent to severe natural
contamination. Extensive tests made by a European laboratory using BPA's
techniques compare very favorably with tests made by BPA. Test equipment,
methods, and results are described, and a table useful for selecting
insulators when designing ehv d-c transmission lines is included.

R202600X67A EHV D-C OUTDOOR INSULATOR FLASHOVER TESTS

Laboratory tests constituting one phase of the insulation coordination
studies were conducted by the Bonneville Power Administration to determine
d-c flashover characteristics of rod gaps, line-to-tower air gaps, and sus-
pension insulator assemblies. Direct-current flashover for test voltages
to 725 kv is shown to be a linear function of specimen length for either
positive or negative polarity or for wet or dry test conditions. Compara-
tive data on flashover characteristics are given for d-c, a-c, and
switching surge test voltages. Test apparatus and procedures used are
discussed. Has 21 references.

R202600X67A

R202615X67A PREPARATION IS KEY TO RELIABILITY IN EHV

New techniques in the preparation of ehv oil-filled equipment for service
assures maximum protection of apparatus and safety of workmen and provides
substantial savings. The Oklahoma Gas and Electric Co and Doble Engineer-
ing Co have collaborated in developing new methods and procedures of using
dry air during preparation of large ehv transformers for service. Initial
inspection of equipment on arrival at its destination is important. Block-
ing and tie rods should be checked for indication of movement during tran-
sit. Gas pressure in gas-filled equipment should be positive and near fac-
tory recorded value when received. The impact recorder should be removed
from the railcar and checked in the presence of factory representatives.
An internal inspection should be made before unloading; however, safety of
inspectors entering the tank must be ensured by partially replacing the
nitrogen gas with dry breathing air. Care must be used in field assembly
to prevent moisture from entering windings. Field personnel must learn
high-vacuum technology and how to use specialized instruments to maintain
and restore windings to the degree of dryness and impregnation attained at
the factory. Several helpful suggestions for field assembly, safety, and
preventing moisture from entering electrical equipment are discussed.

R202615X67A

R202628X67A DISTANCE PROTECTION OF TEED CIRCUITS

Multiended network interconnections such as teed circuits present special
problems in protection. The methods of relaying that have been widely ap-
plied to plain feeders are of limited applicability to circuits having more
than 2 ends within the protected zone. Many of these difficulties and lim-
itations have long been recognized. The authors seek to extend their in-
vestigations by providing a detailed account of the range of relaying con-
ditions encountered in different system configurations in relation to the
application of distance protection. Factors influencing the measurement of
circuit impedance using local-end relaying signals at 3 network terminals
are examined, and a method is suggested by which the loci of impedances
presented to distance protection on faulted and healthy circuits of single-
and double-circuit teed interconnections may be evaluated for different
types of faults. Limiting conditions of assessment in the predetermination
of settings and characteristic shapes of direct intertrip and blocking
schemes are formulated. A computer method is given by which the most ad-
vantageous settings may be secured, subject to constraints derived from the
interconnection to be protected and the range of prospective fault levels
at its terminations.

R202628X67A

R202571 67A FOUNDATION DEFORMATIONS OF CONCRETE DAMS

Stability of concrete dam supports is influenced by forces caused by water
pressure and forces transmitted by the dam. Overall forces caused by water
pressure exerted directly on the surface of the banks do not change with
deformations of the banks, although distribution in the mass depends on me-
chanical structure. Forces caused by penetration of water into the mass
are not known, and their values are estimated from onsite observations.
Distribution of forces transmitted by a dam to its foundations depends on
movements of the foundations which deform under water pressure on the banks
and action of the dam. Accepted methods for calculating these deformations
are not correct and a method using new formulas is presented to determine
the deformations. There is little difference between results from accepted
methods and the new method when applied to thin dams with constant thick-
ness and radii of curvature, located on relatively nondeformable founda-
tions. The proposed method is most applicable to dams on more deformable
foundations or high dams with thick arches of small geometrical bend.
Analysis of this type of dam requires consideration of the variation of
thickness, distribution of forces on the supports, and deformations of the
bank caused by water pressure.

R202571 67A

R202584 67A MONTE CARLO SIMULATION OF PILE ACTION

Interaction of engineered foundations with the earth as a probabilistic environment was investigated. Effect of statistically variable soil deposits on foundation design parameters is of primary concern. The Monte Carlo simulation technique is discussed and applied to a pile foundation problem. Simulation in the context of this paper means that a controlled representation of reality is used to obtain information about the behavior of a system. Replacement of analytical inference with observation by simulation is emphasized. An example is presented for prediction of design variables, such as mean length of friction piles driven into a 2-layer soil deposit overlying rock. Strength of the soil and depth to rock are treated as stochastic variables. Importance of the size of the sample required for a competent simulation is discussed.

R202584 67A

Schimming, B B and Garvey, W A
MONTE CARLO SIMULATION OF PILE PERFORMANCE
Hwy Res Record, No 190, pp 58-64, 1967. U of Notre Dame, Ind, 7 p, 7 fig, 8 ref
DESCRIPTORS-- *pile foundations/ statistical analysis/ *simulation/ design tools/ friction piles/ bearing piles/ numerical method/ *probability/ pile bearing capacities/ *foundations/ *piles
IDENTIFIERS-- *Monte Carlo method

R202596X67A PLANNING A SITE INVESTIGATION

The aim of site investigations is to provide adequate and accurate information for the design of the proposed structure, within the funds allotted. Site investigations can range from a brief site visit to many months of complicated work. Regardless of the magnitude of the investigation, planning and detail supervision will be required. If funds are limited and compromise becomes necessary, reliable information must be provided at the expense of adequacy. Most investigations are performed by drilling and associated techniques. Price ranges are given for various sampling techniques; mobilization cost should be entered as a separate contract item rather than including it in unit prices. Steps in planning the investigation are discussed. Advantage should be taken of any available information on the site (aerial photographs, site inspection, or nearby investigations) before detail planning for the investigation is completed. Three case histories are discussed to illustrate planning and economics of site investigation.

R202596X67A

Hodgson, J D
SOME ASPECTS OF THE PLANNING AND ECONOMICS OF SITE INVESTIGATION
Inst of Engrs, Austrl, Civ Engg Trans, Vol CE 9, No 1, pp 101-106, Apr 1967. Longworth & McKenzie, Sydney, Australia, 6 p, 6 fig, 2 tab
DESCRIPTORS-- planning/ investigations/ *foundation investigations/ costs/ economics/ foundations/ drilling/ *geologic investigations/ *explorations/ soil mechanics/ foreign activities/ *sampling/ projects/ boreholes/ foreign construction
IDENTIFIERS-- Australia

R202613X67A DESIGN OF DYNAMICALLY LOADED FOUNDATIONS

Practical methods for the analysis of foundations subjected to dynamic
loadings are discussed and design methods proposed. The design of founda-
tions subjected to dynamic loads is a trial-and-error procedure. Initial
dimensions are selected by considering such factors as dimensions of the
equipment or structure to be supported, space available for the founda-
tions, and normal static bearing stress. The trial design must be analyzed
to determine its response to the design dynamic loading and then be adjust-
ed and reanalyzed if necessary. These methods of dynamic analysis use a
system of lumped masses, springs, and dashpots approximately equivalent to
the actual foundation soil system. In such lumped systems the mass repre-
sents the inertia present in the actual system while the springs and dash-
pots, respectively, represent all flexibility and damping present in the
actual system. The key step of evaluating the lumped parameters of the
system was obtained from theories of footings resting on semi-infinite
elastic bodies. Has 50 references.

R202613X67A

Whitman, R V and Richart, F E, Jr
DESIGN PROCEDURES FOR DYNAMICALLY LOADED FOUNDATIONS
ASCE Proc, Jour Soil Mech & Fdns, Vol 93, No SM6, Paper 5569, pp 169-193,
Nov 1967. Massachusetts Inst of Tech, Cambridge; U of Michigan, Ann Arbor,
25 p, 7 fig, 6 tab, 50 ref, 2 append
DESCRIPTORS-- design criteria/ design/ *foundations/ *dynamics/ stress/
*live loads/ elasticity modulus/ bibliographies/ models/ earthquakes/
damping/ elastic theory/ coefficients/ Poisson ratio/ laboratory tests/
vibrations/ research and development/ field tests/ analysis/ *flexible
foundations/ footings
IDENTIFIERS-- dynamic response/ shear modulus/ shear waves/ mathematical
models

R202559 67A SELECTION OF A WATER TUNNEL ROUTE

Selection of the most favorable route for the Hausjarvi-Helsinki water
tunnel will be based on engineering-geological studies. The 60-km-long
tunnel, with a cross-sectional area of 10 sq m, will be driven through
a migmatitic part of the Svecofennian schist. Geological studies are
being conducted in 3 stages: preliminary map and aerial photograph study
to select several tentative routes, detailed geological mapping along
tunnel routes and seismic surveys at critical places, and economic com-
parison of the different tunnel routes. Influence of different rocks on
blasting, tunnel lining through weak zones, location of shafts to the
tunnel, and cost of additional geological studies are discussed. An
economic comparison for 3 alternate tunnel routes is given. Has 18
references.

R202559 67A

Niini, Heikki
ON ENGINEERING-GEOLOGICAL STUDIES CONCERNING THE SELECTION OF THE COURSE
OF THE WATER TUNNEL HAUSJARVI-HELSINKI. Engg Geol, Vol 2, No 1, pp 39-45,
Apr 1967. Natl Brd of Pub Rds and Wtwys, Helsinki, Finland, 7 p, 1 fig,
1 tab, 18 ref
DESCRIPTORS-- *engineering geology/ *tunnels/ tunnel design// *water
tunnels /conveyance// *geologic investigations/ rocks/ rock excavation/
geophysics/ bibliographies/ aerial photography/ mapping/ seismic
investigations/ costs/ *subsurface investigations/ explorations/ foreign
projects/ core drilling/ economics/ drilling/ reconnaissance surveys
IDENTIFIERS-- Hausjarvi-Helsinki Tunnel/ Finland/ blasting/ *site
selection

GEOLOGY AND GEOPHYSICS

R202629X67A CHEMISTRY AND THE EARTH

Knowledge of the earth has doubled in the past decade and is forcing a re-
vision of old ideas in light of new findings. The stimulus for research in
geochemistry, geology, and geophysics comes partly from man's boundless
scientific curiosity and partly from the growing need for natural re-
sources. Dramatic new discoveries on the enigmatic structure of the
Mohorovicic discontinuity, radioactive dating, unsuspected inhomogeneity in
the mantle, oceanic and continental heat flows, and high-temperature and
high-pressure research are providing the scientific impetus. Investiga-
tions on continental drift, structure of the earth's core and mantle, age
and origin of the earth, and spontaneous sporadic reversals in the earth's
magnetic field, perhaps the best described and least understood of all
planetary phenomena, are discussed. Practical reasons for earth studies
include: increasing the supply of natural mineral resources, Government
financing of earth science research, availability of newly developed ana-
lytical instruments, need for detection and identification of underground
nuclear explosions, earthquake and volcano prediction, disposal of radio-
active and industrial wastes, and realization of the potential of geother-
mal energy sources.

R202629X67A

HYDRAULICS

R202572X67A PUMP DISCHARGE LINE WATER HAMMER ANALYSIS

In some pumping systems, several 1-way surge tanks are installed to prevent
water-column separation in the discharge line when power failure stops the
pumps. A method to analyze water hammer in a pumping system of this type
is described, assuming that: (1) velocity head in the pipeline is negli-
gible compared with pressure change in the pipeline, (2) distance between
the inlet and outlet of the pump is so short that water hammer waves
propagate from the 2 points instantaneously, and (3) water levels in the
reservoirs do not change during the transient period. To determine
transient conditions caused by power failure, water hammer phenomena in the
pipeline, inertia of the prime mover and pump, pump characteristics, and
other boundary conditions must be considered. Analysis is made by solving
the fundamental equations with a digital computer. An example is calcu-
lated, and results compare quite favorably with field tests.

R202572X67A

Hydraulic transients of varying magnitudes resulting from normal and emergency operation of the California aqueduct are discussed in terms of hydraulic theory. The need for evaluating and the method employed in analyzing these unsteady flow conditions are presented. Additional information is provided on the development of the check structure operations necessary to coincide with normal and emergency flow changes. Three additional means of transient analysis are investigated briefly and employed as a means of confirmation.

R202623X67A   THREE-DIMENSIONAL DENSITY CURRENT

A laboratory investigation of a 3-dimensional density current is described. The density current was produced by the release of salt water at the upper end of a sloping floor immersed in a tank of fresh water. The flow regime was classified as laminar, indeterminate, or turbulent for floor slopes up to 20 deg to the horizontal. The lateral spread of turbulent flows was correlated with a Richardson number measured at the injection orifice. Detailed measurements of velocity and density were made at 3 cross sections of 1 turbulent density current on a floor of 20 deg slope. Velocity and density distribution were found to be reasonably self-preserving when described in terms of 2 characteristic length scales: a characteristic width and a characteristic height of a cross section. Maximum velocity varied as X to the minus 0.7 where X was the distance from a finite virtual line source used to locate the free boundaries of the flow. Mean density excess varied as X to the minus 1.1. The entrainment constant E was found to decrease in the direction of flow.

R202561X67A LONGITUDINAL MIXING IN NATURAL STREAMS

Various models used to describe or predict longitudinal mixing coef-
ficients are examined, and the conditions under which they are expected
to apply are discussed. Several hundred coefficients in laboratory flumes
and natural streams were measured under 2-dimensional, uniform-flow con-
ditions. Coefficients measured in natural streams agreed with equations
derived from flume data. Influence of dead zones in the streams on mixing
was examined; measured coefficients were found to be much closer to pre-
dicted values when the influence of mixing caused by the dead zones was
separated by the use of a new mixing model. Has 27 references.

R202561X67A

R202592 66A RESERVOIR WATER TEMPERATURE UNDER ICE

Under the ice cover of deep through-flow reservoirs there is a thermocline
where temperature and density gradients increase sharply with depth. The
appearance of this layer is attributable to the presence of a current and
the known anomaly of thermal expansion of water, whereby water density in-
creases as the temperature increases from 0 to 4 deg C. The interrelation-
ship between the vertical water temperature and current velocity distribu-
tions under an ice cover are described for cross sections of various parts
of the Bratsk Reservoir. This relationship is explained and its character-
istics and determining factors are examined. An equation is proposed
permitting determination of discharge and current velocity from water tem-
perature distribution in a given cross section of a reservoir.

R202592 66A

In a period of about 300 yr, we have developed a substantial understanding
of the relationship between rainfall and runoff. From Perrault's original
crude experiment confirming the causal relationship between rainfall and
runoff, we have passed through a lengthy era of empiricism caused largely
by inadequate data; a brief period of a quarter century in which a reason-
ably adequate descriptive picture of the runoff process was devised; and,
finally, reasonably rational correlations between precipitation and runoff.
In the computer era we have seen the first demonstration that the runoff
process may be simulated on a computer with a high order of accuracy. If
we take advantage of this development to secure an adequate amount of the
proper kinds of hydrologic data, we can look forward to a completely gen-
eral simulation model which can reproduce the streamflow hydrograph on any
stream, gaged or ungaged, with an accuracy at least as good as that of the
data supplied to the computer. Has 49 references.

R202603X67A EVAPORATION VARIATIONS IN TIME AND SPACE

Daily variations in measured and calculated evaporation rates were ac-
counted for by changes in various weather factors, using simple and
multiple-regression analyses. Partial correlations indicated that solar
radiation accounted for about 70% of the variations in water losses from
dish evaporimeters, whereas the corresponding influences of temperature,
vapor pressure deficit, and wind, as individual factors, were about 35, 0,
and 60%, respectively. However, radiation, temperature, and wind, as com-
ponent factors, each showed a lower correlation with evaporation, whereas
vapor pressure deficit showed a higher and significant correlation. The
degree of association between evaporation and weather factors was greater
when the number of daily observations used in the analysis was doubled.
Multiple-regression analyses showed that the combined effects of the 4
weather parameters were responsible for about 90 and 50% of the observed
variations in evaporation and transpiration rates, respectively. Rates of
evaporation, calculated by the multiple-regression equations, agreed well
with evaporation observed on days other than those used for making the
regression. Significant correlations also were found between evaporation
from small dishes and a U S Class A pan and between evaporation and tran-
spiration from grass in lysimeters.

R202588 67A   IRRIGATION REQUIREMENTS AND SOIL TEXTURE

Minimum annual irrigation water requirements were determined in 17 mature
orchards over a 4-yr period by gradually reducing the application rates
until the desired minimum soil-moisture contents were achieved. Variations
in weather were considered in the scheduling procedure. Criteria used for
determining minimum requirements allowed for some wilting of cover crops
but not of trees. The soils ranged from a sand to a fine silt loam, with
accompanying wide ranges in water-holding capacity, depth of water needed
at each irrigation, and safe irrigation intervals in the heat of summer.
Highly significant correlations were obtained between the annual irriga-
tion requirement and the soil texture and net evapotranspiration. By
multiple-regression, these 2 factors, together with number of days of
irrigation, accounted for 91 to 94% of the variation in annual irrigation
applications. The conclusion was that the coarser-textured the soil, the
greater the annual irrigation requirement. Has 20 references.

R202588 67A

Wilcox, J C
EFFECTS OF SOIL TEXTURE, NET EVAPOTRANSPIRATION AND OTHER FACTORS ON
IRRIGATION REQUIREMENTS OF ORCHARDS AS DETERMINED BY A SCHEDULING
PROCEDURE. Canadian Jour of Soil Sci, Vol 47, No 3, pp 149-156,
Oct 1967. Canada Dept of Agrl, Summerland, 8 p, 6 tab, 20 ref
DESCRIPTORS-- soils/ soil science/ irrigation/ *irrigation practices/ soil
moisture/ irrigation O&M/ bibliographies/ *evapotranspiration/ weather/
rainfall/ field tests/ fruits/ trees// consumptive use /water// silty
loams/ *water requirements/ *soil texture/ soil structure/ sands/ cover
crops
IDENTIFIERS-- *irrigation requirement/ multiple regression/ water
application rate/ orchards

R202616 67A   ALGAE CONTROL IN IRRIGATION CANALS

Efforts to control algae and aquatic weed growth in the Friant-Kern and
Madera Canals of the Central Valley Project in California are described.
Canal capacity, particularly in concrete-lined sections, can be reduced
significantly by this growth. The Madera Canal capacity was reduced by 29%
when algae was allowed to grow unchecked. In a large canal such as the
Friant-Kern a loss of 10% of capacity amounted to 900 acre ft/day. Fur-
thermore, with algae conditions present, developing an accurate stage-
discharge relationship in the canals for measurement purposes is impos-
sible. Of several different soil sterilants and methods tried, the most
successful was dumping fine copper sulfate crystals into the flowing water.
Satisfactory algae control was obtained with only 1 lb of crystals per cfs
in the Friant-Kern Canal and 2 lb/cfs in the Madera. A description of the
successful technique used and breakdown of costs are given.

R202616 67A

Nielsen, Geoffrey D
PRACTICAL METHOD OF CONTROLLING ALGAE IN IRRIGATION CANALS
Paper, ASCE Water Resrcs Conf, New York, N Y, Oct 1967. Bureau of
Reclamation, Sacramento, Calif, 25 p, 5 fig, 6 photo, 1 tab
DESCRIPTORS-- *algae/ *irrigation canals/ canals/ *open channels/ weeds/
laterals/ *aquatic weeds/ *weed control/ *copper sulfates/ canal linings/
water measurement/ operation and maintenance/ capacity reduction/ costs/
chemicals/ benefits/ agronomy/ trashracks/ irrigation systems
IDENTIFIERS-- Central Valley Proj, Calif/ *aquatic weed control/ pondweed

Although only a few examples of experimental mechanics and its role in
structural analysis are discussed briefly, indications are that such tech-
niques are powerful analytical tools warranting more extensive use. Design
problems can be the result of oversights or failure to define the problem.
Of the latter, a typical example is the case where a part is overdesigned
to reduce the stress, whereas a correct solution would be to remove some of
the material from a low stress region. Simple photoelastic models that can
be made with a pair of shears and a punch are used to illustrate how design
problems can be defined and solved.

R202568X67A AUTOMATION IN THE LABORATORY

On-line digital computers are providing new freedom in the design and con-
duct of laboratory experiments. For the first time the scientist can pro-
gram his entire experiment by mixing, as necessary, measurements, delays,
computations, decisions, reporting functions, and requests for guidance.
Steps involved in converting laboratory experiments from classical experi-
mental situations to fully automated processes include: generation of ex-
perimental data in machine-readable form, preparation of the experimental
plans in computer program format to direct and control the experiment,
preparation of a decision-making computer program to join the data analysis
program and the input preparation program, and execution of the experimen-
tal processes in an on-line environment by electronically connecting the
experimental apparatus to the computer. In the last few years, differences
between industrial process control and laboratory automation have become
clearer. Experience has shown that: (1) laboratory automation is less
expensive than industrial process control because the need for reliability
and redundancy is not as great and (2) laboratory automation demands much
greater versatility in terms of computer hardware and software components.
Unfortunately, because techniques of laboratory automation are radical,
adequately describing their effects on research is difficult.

R202591X67A FRACTURE TOUGHNESS

Fracture toughness is a relatively new parameter for estimating the ability
of a material to arrest a crack that could cause sudden failure below the
yield strength. Unlike transition temperature, impact strength, and
notched-unnotched strength ratio, fracture toughness appears to be a mate-
rial constant unaffected by specimen geometry. Fracture toughness repre-
sents the critical stress-intensity factor in the vicinity of the crack
front and is related directly to the energy for crack propagation. As
thicker specimens are considered, the energy needed for crack propagation
decreases. At some critical thickness, crack propagation is governed by
plane-strain conditions and the stress-intensity factor reaches a minimum.
The minimum plane-strain stress-intensity factor is pertinent in materials
evacuation because it is a constant essentially independent of specimen
dimension. The initiation of slow crack growth also is governed by plane-
strain conditions so that the stress-intensity factor not only character-
izes total failure in thick sections but controls the stress extending
cracks in thinner sections. Examples of fracture toughness applications
are given for selection of steel for pressure vessels, evaluating base and
weld metals, determining the safety of structures, and predicting fatigue
behavior. Basic methods for determining fracture toughness are discussed.

R202591X67A

Steigerwald, Edward A
WHAT YOU SHOULD KNOW ABOUT FRACTURE TOUGHNESS
Metal Progress, Vol 92, No 5, pp 96-101, Nov 1967. Thompson Ramo Wool-
dridge, Inc, Cleveland, Ohio, 6 p, 3 fig, 1 tab
DESCRIPTORS-- materials/ metals/ *metals testing/ design criteria/ alloys/
pressure vessels/ safety/ *fractures/ *cracking// failure /mechanics// test
procedures/ *strength of materials/ *structural design/ strain/ elasticity/
*notch tests/ *toughness/ stress welded joints/ laboratory tests/ materials
testing
IDENTIFIERS-- crack propagation

R202621 67A BITUMEN FOR HYDRAULIC STRUCTURES

Bitumen is suitable for many different applications in hydraulic engineer-
ing because of its advantageous chemical and physical properties. These
properties include high resistance to atmospheric effects; thermoplastici-
ty; insolubility in water; low specific heat; nontoxicity; resistance to
acids and caustic solutions; and variable plasticity, depending on the
mineral aggregate. Asphalt is often used as an impermeable lining for
reservoirs and embankments when other materials are too expensive and
external forces require a flexible structure. Paving grade-, oxidized-,
cutback-, and emulsion-type bitumens are discussed briefly. Examples are
given of the application of bituminous materials on European hydraulic
engineering projects for coast protection, reservoir linings, dam construc-
tion, harbor engineering, and canal linings.

R202621 67A

Rose, D
BITUMEN FOR HYDRAULIC STRUCTURES
Proc, 7th World Petrol Conf, Mexico City, Mexico, pp 109-130, Apr 1967.
BP Benzin und Petrol AG, Germany, 22 p, 12 fig, 13 ref
DESCRIPTORS-- *asphalt/ *asphaltic concrete/ *bituminous materials/ canal
linings/ linings/ waterways/ coastal engineering/ earth dams/ rockfill
dams/ embankments/ seepage/ reservoirs/ jetties/ beach erosion/ foreign
projects/ foreign design practices/ foreign construction/ sea walls/ dikes/
flexible linings/ deformation/ underwater construction/ *hydraulic
structures/ channels/ ports/ materials
IDENTIFIERS-- harbors/ asphalt membranes/ asphalt mattresses/ Europe

R202622 67A RECLAMATION USES OF PETROLEUM PRODUCTS

Applications of petroleum products in Bureau of Reclamation water resources
development projects are described. These applications include asphalt
canal linings, asphaltic concrete dam facings, plastic canal linings,
plastic cutoff curtains, plastic pipe, and chemical soil sealants. A sum-
mary of different types and costs of canal linings installed on Bureau
projects is given. Average installation costs of bituminous linings range
from $1.50 to $3.00/sq yd for asphaltic concrete, $1.35 to $1.75/sq yd for
prefabricated asphalt membrane, and $0.90 to $1.10/sq yd for buried asphalt
membrane. The most promising plastic canal lining appears to be polyvinyl-
chloride; over 127,000 sq yd of buried 10-mil-thick-polyvinylchloride mem-
brane have been installed at a cost as low as $0.75/sq yd. Design and con-
struction of hot-mix asphaltic concrete dam facings for Bonny Dam, Colo;
Glen Anne Dam, Calif; and Montgomery Dam, Colo, are discussed. Laboratory
and field investigations of chemical soil sealants are somewhat encouraging
although no material thus far has met completely all requirements satisfac-
torily. Bureau experiences with other types of bituminous linings, under-
sealings, sublinings, joint fillers, plastic cutoff curtains, and plastic
pipe are summarized briefly.

R202622 67A

Burnett, Graydon E
APPLICATIONS OF PETROLEUM PRODUCTS IN BUREAU OF RECLAMATION CONSTRUCTION
Proc, 7th Intl World Petrol Conf, Mexico City, Mexico, pp 37-53, Apr 1967.
Bureau of Reclamation, Denver, Colo, 17 p, 4 photo, 2 tab, 9 ref
DESCRIPTORS-- *canal linings/ flexible linings/ underwater construction/
*asphalt/ *asphaltic concrete/ *bituminous materials/ plastic tubing/
plastics/ linings/ hydraulic structures/ sealing compounds/ joint fillers/
seepage/ cutoffs/ costs/ lower cost canal linings/ membranes/ earth dams/
*buried membranes
IDENTIFIERS-- polyvinyl chloride/ soil sealants/ chemical sealants/ *dam
facings/ *asphalt membranes

R202569X67A COMPUTER TIME SHARING--A REVIEW

Time sharing is the simultaneous utilization of a centrally located comput-
er by several users. Generally, the basic hardware used for time-sharing
systems is the same as conventional batch processing equipment. Additional
hardware features necessary for time-sharing systems include: memory pro-
tection, program interrupt, built-in clock, dynamic program relocation,
auxiliary storage, and typewriter consoles connected to the computer
through communication lines and data transmission terminals. The authors
review the present and future services of time sharing and describe the
main hardware and software features of a time-sharing computer. Until now,
the electronic computer has been used either to relieve man of routine work
or carry out complex and lengthy computations. In a time-sharing system,
the computer can be used as an assistant to the engineer or research sci-
entist in his creative work, thereby enabling him to scan a large number of
solutions quickly. Time sharing is a big step toward the improvement of
man-machine relations, as it permits undelayed conversation between man and
machine.

R202569X67A

Pointel, Nicole and Cohen, Daniel
COMPUTER TIME SHARING--A REVIEW
Computers and Automation, Vol 16, No 10, pp 38-46, Oct 1967. Lab Central
de Telecom, Paris, France, 9 p, 1 fig
DESCRIPTORS-- *computer systems components/ characteristics/ *computers/
computer programming/ *data processing systems/ automation/ reviews/
systems analysis/ methodology/ engineering services/ computation/
communications/ programming languages/ technology/ operations
IDENTIFIERS-- *time sharing/ *software/ man-machine systems/ problem
solving/ France/ use potential// *hardware /computer/

R202576X67A   HYBRID COMPUTERS

Combining the advantages of analog and digital computers, the hybrid often
becomes the fastest and least expensive way of analyzing the dynamics of
complex systems. Types of hybrids and their applications, functional sub-
units, and programming techniques are discussed. Many levels of hybrid-
ization have been developed, varying in type from pure analog to pure digi-
tal computers. Hybrid computers are best suited for solving: problems in-
volving system optimization and those dealing with distributed parameters
(partial differential equations); simulation of problems handled primarily
by an analog computer but requiring accuracy and reliability of a digital
computer for certain calculations; simulation of problems handled primarily
by a digital computer but requiring an analog computer for certain calcula-
tions that would be impractical to perform with a pure digital system; and
problems requiring simultaneous processing of analog and digital data. Hy-
brid computers consist basically of 3 functional subunits: analog and digi-
tal computers and intracom. The intracom consists of analog-to-digital and
digital-to-analog converters, permitting communication between analog and
digital computers. Problem-oriented languages such as FORTRAN are well-
suited for programming the hybrid; however, special diagnostic and utility
programs are also necessary to achieve maximum operating efficiency.

R202576X67A

R202577X67A   ON-LINE SYSTEMS AND MAN-COMPUTER GRAPHICS

Engineers have acquired new tools for design and analysis through time
sharing and visual display systems. Time-sharing systems are designed to
provide individual computational service from many remote terminals to a
large central processor. Several groups have been developing special man-
computer interactive (conversational mode) languages for use at these
relatively new terminal facilities. The intent is to provide programming
or problem-solving capability directly to users in languages familiar to
them. All of these systems are designed to permit the engineer to approach
the computer terminal, enter a mathematical problem, and receive an imme-
diate solution. Concurrent with the development of on-line systems has
been the growth of visual communications with computers. The powerful
synthesis of input with visual output in on-line systems has created a new
dimension in computer technology--man-computer graphics (MCG). This con-
cept, having emerged within the past 3 yr, permits the individual to
interact with the computer in 2 ways through the medium of visual display.
Several applications characterizing MCG include: numerical control (parts
programming), electronic design, dynamic analysis, and structural analysis.
To achieve the full potential of MCG, a time-shared environment must be
employed. Has 39 references.

R202577X67A

Methods for solving the optimization problem and their implications, limitations, and applications are discussed. Methods range from trial-and-error to classical analytic techniques. Trial and error is unworkable with large combinations of variables; classical procedures have not been successful in producing numerical results. A new computational approach, dynamic programming, combines analytical and numerical procedures into functional equations for large high-speed computer manipulation. Up to the point where numerical results are sought by some computational algorithm, classical analysis and dynamic programming are virtually indistinguishable. Solutions are difficult to achieve by either method because of the inherent complexities imposed by boundary-valuedness in classical methods and dimensionality in dynamic programming. Concepts of invariant imbedding and Pontriagin's maximum principle are reviewed for reducing complexities in classical procedures. The most promising computational procedure for overcoming multidimensionality and boundary-valuedness obstacles is linearization and successive approximation. Polynomial approximation to reduce dimensionality and computer memory requirements is covered. An example of setting up the boundary value problem and solving it by classical and dynamic programming methods is given. Has 28 references.

R202589 64A

Peterson, E L
THEORY, METHODS AND APPLICATION OF OPTIMIZATION TECHNIQUES
Paper, Advisory Group for Aerospace R&D, Dusseldorf, W Germany, Oct 1964.
Defense Res Corp, Santa Barbara, Calif, 50 p, 28 ref
DESCRIPTORS-- *mathematics/ mathematical analysis/ *optimum design/ peak values/ *boundary values/ calculus/ computation/ bibliographies/ computer programming/ digital computers/ numerical method/ *operations research/ linear systems/ nonlinear systems// series /mathematics// differential equations/ methodology/ computers/ matrix algebra
IDENTIFIERS-- optimum performance/ *optimization/ problem solving/ approximation method/ *dynamic programming

R202617X67A DATA REDUCTION TECHNIQUES

Today's engineer is faced with the burden of collecting increasing masses of test data and reducing the data into meaningful terms for product design and development. The engineer must determine early in the test program how the various test data generated will be used: i.e., long- or short-term storage, mathematical processing or statistical analysis, graphical representation, and similar questions. Two major factors that should be considered when determing how to process data are: amount of data to be generated and degree of mathematical manipulation required to analyze the data. Several approaches to data handling are examined through the use of digital techniques and data processing equipment. Types of storage media reviewed include punched cards, punched paper tapes, magnetic tape, and magnetic disc. A generalized table for comparing cost, flexibility, speed, and volume characteristics of each storage medium is presented. The pre-processor, a small computer used for editing, checking, formating, and compressing source data when operating in a real-time environment, is discussed.

R202617X67A

Decker, Fred
DATA REDUCTION TECHNIQUES
Machine Design, Vol 39, No 27, pp 149-155, Nov 23, 1967. Honeywell Inc, Waltham, Mass, 7 p, 9 fig, 1 tab
DESCRIPTORS-- *data reduction/ *digital recording systems/ *magnetic tapes/ *punched paper tapes/ data collection systems/ digital computers/ magnetic recording/ *data storage systems/ measurement/ calculations/ mechanization/ statistical analysis/ mathematical analysis/ experimental data/ computer programming/ methodology/ records
IDENTIFIERS-- *punched cards/ application techniques/ *preprocessor (computer)

R202573X67A   ANALYSIS OF VARIABLE-PITCH PUMP TURBINES

A method of analyzing transient behavior of a pump turbine with variable-pitch blades is presented. Equations describing the behavior of a unit during transient periods are found by interpolation of the unit's characteristics. These equations are solved simultaneously with water hammer equations to describe the behavior of an entire system during a transient period. Complete performance characteristics of a variable-pitch pump turbine are presented. Example problems using these characteristics illustrate the method of analysis; they prove that variation in blade pitch is very important in predicting the head across the unit, discharge through the unit, and speed of the unit during a transient period. An application of this method of analysis is given, using a complete set of characteristics for the Forebay pump turbines at the San Luis Unit, Central Valley Project, Calif. Has 23 references.

R202573X67A

DeFazio, F G
TRANSIENT ANALYSIS OF VARIABLE-PITCH PUMP TURBINES
Trans of ASME, Jour Engg for Pwr, Ser A, Vol 89, No 4, pp 547-557, Oct 1967. Harza Engg Co, Chicago, Ill, 11 p, 17 fig, 23 ref, append, disc
DESCRIPTORS-- analysis/ *pump turbines/ hydraulic machinery/ torque/ water hammer/ *hydraulic transients/ bibliographies/ forecasting/ curves/ turbine blades/ *characteristics/ discharges/ velocity/ computers/ moments of inertia/ pumps/ impellers
IDENTIFIERS-- Central Valley Proj, Calif/ San Luis Unit, Calif/ *load rejection/ *variable-pitch blades/ Forebay Pump Plt, Calif

R202619X67A   GROOVE WELDING OF THICK STEEL PLATE

Studies of metal arcs close to workpiece walls show that a new technique can be used for welding thick materials. The pieces to be joined are placed in a square butt configuration with a 1/2-in. separation. After attaching suitable backing, a large wire is fed into the groove separating the pieces and a straight-polarity arc is energized. As the arc is moved along the groove, the controlled globular transfer that occurs at the specified welding conditions forms a weld bead tying together the previous bead and both walls of the groove. Sound welds in steel plate up to 6 in. thick have been made in the flat position using a 1/8-in.-dia wire at a deposition rate of 24 lb/hr. The guide tube is normally above the workpiece and the wire extension is initially slightly longer than the groove depth. Power is supplied from a nearly flat-slope source with little added inductance at about 33 to 35 v and 400 to 450 amp. Carbon dioxide is quite satisfactory as the shielding gas for welding carbon steel; as much as 90% can be replaced by helium or 50% by argon if a less oxidizing atmosphere is desired. The welding procedure is discussed. A diagram of shielded gas mixtures permitting sound welds and a table of weld properties are included.

R202619X67A

Jackson, J E and Sargent, H B
STRAIGHT-POLARITY GROOVE WELDING OF THICK STEEL PLATE
Welding Jour, Vol 46, No 11, pp 905-914, Nov 1967. Union Carbide Corp, Indianapolis, Ind, 8 p, 13 fig, 3 tab
DESCRIPTORS-- *welding/ welded joints/ *arc welding/ carbon dioxide/ butt joints/ *steel plates/ *thick plates/ electric arcs/ electric currents/ electric potential/ direct currents/ electrodes/ mechanical properties/ mechanical engineering/ notch tests/ cathodes/ helium
IDENTIFIERS-- polarity/ welds/ weldments

R202627X67A BRITTLE FRACTURE OF WELDED STEEL PLATES

The contribution of residual stress and metallurgical damage to low-
strength brittle fracture of large, welded, mild steel plates was investi-
gated. Conclusions were: (1) in welded structures residual stress plays a
major role in low-stress brittle fracture, and (2) metallurgical damage is
a minor factor. Reduction of residual stress by a certain amount corre-
sponded to an increase in load-carrying capacity of about the same amount.
A hypothesis is suggested, relating residual stress and load stress to the
type of malfunction (ductile failure, full-width brittle fracture, and for-
mation of primary or spontaneous cracks). The hypothesis supports the con-
cept that residual stress and load stress can be combined in design against
low-strength brittle fracture. Further analysis of the exhaustion of duc-
tility concept indicates that this concept is valid for unwelded, notched
plates but cannot be extended to welded plate specimens. Has 22 refer-
ences.

R202627X67A

R202587X67A NEW CONCEPTS IN POWER PLANNING

The author contends that present concepts governing use of natural power
resources are outdated and wasteful. Rationalization by acceptance of the
real value of today's water and effects of long-term inflation and im-
proving thermal efficiencies are of vital importance. A new dimension to
accepted thinking is introduced and could result in a radical worldwide
shift in favor of water power. Topics examined include: (1) adequacy of
the existing economic framework within which alternative power resources
are examined for the needs of today and tomorrow, (2) inherent character-
istics of the various sources of power, and (3) economic studies made
today for withstanding the test of time to provide power at a predeter-
mined rate without being distorted by inflation. The discussion is
confined to the waste involved in not using water power when it is avail-
able, waste involved in using other fuels for generation of electric
energy at low rates of conversion, and effect of inflation on costs of
generation.

R202587X67A

R202590 67A   SITE INVESTIGATION PLANNING

Stages of site investigation in common practice on engineering projects in
Britain and America are reviewed. To help logistical and technical ap-
praisal of an investigation, critical path planning based on the antici-
pated geology of the site is discussed. A basic 3-stage site investiga-
tion scheme is presented: the preliminary site exploration and detailed
site investigation, both of which are more or less completed before con-
struction starts, and the foundation investigation conducted during con-
struction. Case histories are given illustrating how geometry of the site
geology, together with engineering requirements of the project, can be
used to guide the layout and program of the investigation and help estab-
lish criteria for design parameters. Gives 18 references.

R202620X67A   GROSS DOMESTIC PRODUCT OF IRRIGATION

A method of evaluating secondary incomes (mainly urban) resulting from a
completed irrigation project is described. The method consists of building
a financial model of the irrigated zone including its market town. Four
main conclusions are reached: (1) secondary incomes, or the gross domestic
product (GDP), from an irrigation project can be estimated with a reason-
able degree of accuracy from ascertainable data; (2) on any given increase
in agricultural goods sold, the rise in secondary GDP can be calculated to
amount to between 150 and 350% of the increase, while tax yields will be
anything from over 40 to 100% of it; (3) an irrigation project which is
technically successful but cannot be wholly paid for from increased farm
profits is likely to be fully economical from the national viewpoint when
the taxes it generates are credited to it; and (4) farmers are likely to
benefit least from irrigation projects and should not be charged more than
their proportion of the cost.

Biaxial compression tests were performed on steel balls of equal size to
further the theory of mechanics of granular material proposed by Mogami.
Most of the assumptions contained in the theory were verified by experi-
mental observation. A flat box composed of 4 movable sidewalls and a
plate glass bottom was used in the experiment. Two opposite walls could
be moved toward each other simultaneously while the other pair of walls
was at rest until the horizontal forces exerted by the particles exceeded
the resisting force of the friction between walls and glass bottom. When
a loosely packed assemblage of steel balls is compressed it becomes denser
until the void ratio approaches a certain critical value before failure.
The value k, previously proposed as a parameter relating void ratio, change
in void ratio, and shearing strain, was found to be almost constant at
failure regardless of the initial arrangement of the balls. However, the
critical void ratio obtained from this investigation does depend on the
initial arrangement. Expressions relating void ratio and angle of internal
friction obtained earlier are still valid even if nonzero constant values
of the critical void ratio obtained from these experiments are introduced.
Several photographs of the configuration of the balls during compression
are included.

R202585 67A ANISOTROPIC CONSOLIDATION OF CLAY

If a soil specimen is consolidated under any conditions other than those
to which it has been subjected previously, its structure will be altered
and changes in its strength characteristics will result. An anisotropical-
ly consolidated remolded homogeneous clay was investigated to determine ef-
fect of secondary inherent strength anisotropy (caused by variation of the
consolidation stress path and principal consolidation stress ratio) on the
strength response of the clay. Findings indicated that strength character-
istics were influenced by: (1) initial soil structure before anisotropic
consolidation or primary inherent strength anisotropy and (2) structural
rearrangement of particles caused by anisotropic consolidation or secondary
inherent strength anisotropy. The stress path followed to obtain a given
principal consolidation stress ratio influenced soil response. Pore-
pressure values during a strength test decreased with increasing values of
the principal consolidation stress ratio. With one exception, respective
failure strains for the maximum deviator stress and stress ratio failure
criteria were approximately equal. Water content for a given octahedral
normal consolidation stress decreased with increasing values of the prin-
cipal consolidation stress difference.

R202597X67A A REVIEW OF THE VANE TEST

The theory and application of the vane shear test is reviewed for materials
that are saturated and indicate a zero angle of shearing resistance in the
unconsolidated, undrained triaxial test and for materials that are partial-
ly saturated and exhibit an angle of shearing resistance in the unconsoli-
dated, undrained triaxial test. Theory of the vane test for materials with
an angle phi of zero is well developed and results of sampling investiga-
tions and in situ failures confirm this theoretical work. The vane test
can be used with confidence for short-term end-of-construction analyses in
nonfissured, saturated clays. The test has been found to be extremely use-
ful in very soft and sensitive clay soils. Experimental results of vane
tests in fissured clays, sandy clays, and sands, giving an angle of shear-
ing resistance phi in the undrained triaxial test are described. Little
correlation with any existing theories has been determined. As the mechan-
ics of the vane test in inserting and rotating the vane in these soils is
extremely complex, their behavior should be determined in the triaxial test
where the stress conditions can be more closely controlled. Has 111
references.

<div align="right">R202597X67A</div>

R202609X67A VIBRATORY PENETRATION OF SOILS

A vibratory penetration process for soils is analyzed. The direction of
vibrational motion is the same as the direction of penetration. An approx-
imate expression is found for penetration rate of a flexible penetrator
with applied bias and harmonic forces. The penetrator is modeled as 2
masses joined by an elastic member with damping. Modified Coulomb friction
is used to characterize soil resistance. The approximate expression is
compared with analog computer measurements and an exact theory (developed
for the limiting case of zero front mass and internal damping) and is found
to give good agreement in the range of small excess harmonic force ampli-
tude. Comparison with a rigid penetrator is made, and the flexible pene-
trator is shown to have the important design advantage of lower weight or
lesser applied harmonic force for equal penetration rates. Four general
approaches explaining the effects of vibration on soil penetration are
given and discussed.

<div align="right">R202609X67A</div>

A general method of steady state seepage analysis using the finite-element method is developed for use on the digital computer. The method is based on the concept of representing the continuous distribution of pressure head in the region of flow by values of head at a finite number of points. The seepage problem is considered solved when the head at these points is known. Seepage through dams and around a double-wall cofferdam near the face of a slope is considered. The seepage region may be nonhomogeneous and nonuniformly anisotropic. A method of locating the top flow line or seepage line within specified limits of accuracy is presented. With this capability, the method is general enough to solve any practical problem of steady seepage. Solution of any seepage problem is reduced to a standard simple routine requiring negligible engineering time. The computer routine used by the method and an example problem are discussed.

R202610X67A

R202611X67A EMBANKMENT DRAINAGE AFTER DRAWDOWN

A method is presented for determining the position of the saturation line and percent drainage in the upstream portion of an earth dam following complete or partial drawdown of the reservoir. The method is based on: (1) a dimensionless time factor which is a function of elapsed time, permeability, effective porosity, and boundary conditions; and (2) a drawdown ratio expressing the drop in reservoir elevation as a function of the original height of water above the slope. Since an evaluation of slope stability under drawdown conditions is dependent upon pore pressures related to the position of the saturation line, a quick method of predicting its location is desirable. Drainage theory used in this method is similar to the approach proposed by Casagrande for evaluating base course drainage of airfield pavements and later adapted by Shannon for use in dams. Expressions are derived for predicting the effect of partial drawdown. Model studies indicate that hyperbolas related to a coordinate system (a function of the time factor and drawdown ratio) can be used to define the saturation line.

R202611X67A

R202612X67A   CLASSIFICATION & IDENTIFICATION OF SHALES

Shale has been regarded as a troublesome and generally undesirable founda-
tion material; however, all shales do not create foundation problems. A
classification system distinguishing the problem shales from the nonproblem
shales is proposed. From an engineering viewpoint, a classification based
on physical properties such as compressive strength, peak and residual
shear strength, activity ratio, potential swell, elastic modulus, and pre-
dominant clay minerals is more useful in predicting probable in situ be-
havior of shale than a purely geological classification. Shales can be
classified broadly into 2 groups as compaction or soil-like shales and ce-
mented or rock-like shales. Generally rock-like shales provide satisfac-
tory foundations with a minimum of problems, whereas case histories are
replete with failures of structures and slopes founded on compaction shale,
particularly clay shales. Clay shales are the major problem shales; in
many cases their in situ behavior is unpredictable and puzzling in spite of
thorough field and laboratory investigations. A table relating probable in
situ behavior with physical properties is included along with a table indi-
cating the physical properties of several North American shales. Has 38
references.

R202612X67A

Underwood, Lloyd B
CLASSIFICATION AND IDENTIFICATION OF SHALES
ASCE Proc, Jour Soil Mech & Fdns, Vol 93, No SM6, Paper 5560, pp 97-116,
Nov 1967. Corps of Engrs, Omaha, Nebr, 20 p, 3 fig, 2 tab, 38 ref
DESCRIPTORS-- *shales/ clay shales/ *soil classifications/ classifications/
foundations/ bibliographies/ *physical properties/ compressive strength/
elasticity modulus/ cohesion/ internal friction/ dry density/ sedimentary
rocks/ moisture content/ clay minerals/ soil structure/ permeability/ pore
pressures/ shear strength/ geology/ *engineering geology
IDENTIFIERS-- *cementation/ strain energy/ in situ rock

R202618 67A   STRAIN ENERGY AND OVERCONSOLIDATED SOILS

Quantitative evidence, gathered from a series of large-scale consolidation
tests, supports Bjerrum's recently presented strain energy hypothesis. The
hypothesis qualitatively explains the behavior of overconsolidated clays
and phenomena of long-term slope failures in these soils. The coefficient
of earth pressure at rest was found to be a function of strain energy at a
given value of the overconsolidation ratio. Degree of disintegration of
overconsolidated soils during a slaking test is shown to be related to
strain energy. Tests indicate that mineralogy and the capacity of a soil
to adsorb strain energy are related. Evidence suggests that certain physi-
cochemical properties may be related quantitatively to mechanical proper-
ties through the concept of strain energy.

R202618 67A

Brooker, Elmer W
STRAIN ENERGY AND BEHAVIOUR OF OVERCONSOLIDATED SOILS
Canadian Geotech Jour, Vol 4, No 3, pp 326-333, Aug 1967. U of Alberta,
Edmonton, Canada, 8 p, 5 fig, 2 tab, 8 ref
DESCRIPTORS-- *strain/ *energy absorption/ *overconsolidation/ laboratory
tests/ *stress-strain curves/ soil physical properties/ internal friction/
consolidation/ deformation/ clays/ remolded soil samples/ *soil mechanics/
earth pressures/ stress relieving/ plasticity/ slaking/ mineralogy/ soils/
disintegration/ weathering
IDENTIFIERS-- *strain energy/ diagenetic bonds/ foreign research/ *slope
stability/ Canada

The effect of soil packing as measured by bulk density and hence porosity
on the hydraulic properties of 3 disturbed soils was studied and results
are reported. Soil packing as measured by bulk density and porosity is
related to bubbling pressure, pore-size distribution index, and permea-
bility. With a light hydrocarbon oil as the wetting fluid, the pore-size
distribution index was changed only slightly over a wide range of porosi-
ties. Permeability and bubbling pressure, on the other hand, were changed
severalfold over the same range of porosities. For modeling purposes, 1
requirement for similitude between model and prototype is identical values
of pore-size distribution index. Evidently, bubbling pressure may be
adjusted to suit the size of the model by changing the packing density
without appreciably changing the pore-size distribution index.

Large intake structures, penstocks, and spiral casings for the 3 low-head
hydroelectric power stations comprising the Lower Derwent Power Develop-
ment, Tasmania, were designed as prestressed concrete structures. The pre-
stressing techniques reduced expected differential deflections transmitted
to the main bearings, improving the operating conditions of the power-
plants. Meadowbank Power Station having the highest operating head of the
3 stations is discussed in greatest detail. Prestressed concrete was used
in the design of the stations because of high loads imposed on the compo-
nents, economy over steel, and more watertight structures than regular con-
crete would produce. Meadowbank is the first power station in the world to
have a spiral of prestressed concrete. The Freyssinet 12-1/2-in. Multi-
Strand prestressing system was chosen mainly because of construction expe-
diency. The foundation at the Meadowbank station consists of rock with
vertical joints containing relatively wide bands of soft material. Since
the rock could not be relied on to produce a support sufficiently unyield-
ing to prevent cracking of the concrete spiral, the structure was designed
to be self-supporting without assistance from the foundation. Stressing
techniques and safety during stressing are discussed. Jacking tests on the
Meadowbank spiral case are included in an appendix.

STRUCTURAL AND ARCHITECTURAL ENGINEERING

R202605X67A GYPSUM MORTAR FOR MODELS

In using small-scale models for determining inelastic response of rein-
forced concrete structures, accurate modeling of materials is one of the
most difficult problems. A high-strength gypsum mortar was investigated
as a model material for simulating concrete in small-scale models.
Similitude requirements for model materials are discussed briefly, and
tests are described for determining the appropriate physical properties
of trial mixes. Gypsum mortar is shown to behave similarly to prototype
concrete and has several advantages over model cement mortars. Size
effects on compressive and tensile strengths are studied and a surface
sealing technique is used to reduce size effects. Charts for propor-
tioning mixes of different strengths and several references on successful
applications of gypsum mortar are included.

WATER RESOURCES

R202624X67A SUPPRESSING SNOW EVAPORATION

Studies in California, Sweden, and Lapland indicate evaporation from snow
can be reduced by applying long-chain fatty alcohols. The physical action
of long-chain alcohols on snow is not known and information is needed on
spreading rates and distribution patterns. Laboratory studies at Colorado
State University (under contract with the Bureau of Reclamation) on the
spreading of hexadecanol on a melting snow surface are described. Carbon
14 labeled hexadecanol and autoradiograph techniques were used to determine
hexadecanol distribution on a melting snow surface. Snow-filled evapora-
tion pans treated with several long-chain alcohol powder and emulsion mix-
tures were used to determine reductions in evaporation. Results indicate
that long-chain alcohols can spread on a melting snow surface and that a
10% hexadecanol-octadecanol emulsion is superior to powder applications.
Further studies are necessary to determine the practicality of field appli-
cations.

R202625X67A   PESTICIDE POLLUTION CONTROL

Water pollution by pesticides began some 22 yr ago; fish kills associated
with agricultural applications of chlorinated hydrocarbon insecticides were
the first evidence of this new type of water pollution. The 2 principal
sources of water pollution are runoff from pesticide-treated land and in-
dustrial waste discharge. Recent surveys have shown the widespread distri-
bution of pesticides in water. Present information is fragmentary concern-
ing effects of pesticide pollution but is sufficiently suggestive to alarm
ecologists. Water quality criteria on pesticide concentration in water are
reviewed. A method is presented for determining the concentration limits
for organophosphate and carbamate pesticides. The procedure measures the
effect of these pesticides on fish rather than determining the actual pes-
ticide concentration in water. Measurement of the effect of chlorinated
hydrocarbons in an aquatic ecosystem is much more difficult and presents
problems which have not been solved. Full control of chlorinated hydrocar-
bon pollution is not presently attainable. Point sources of pollution can
be determined by monitoring waste effluents, thus providing a first step in
control of this type of pollution. Has 29 references.

R202625X67A

R202626X67A   LIVING MEMBRANES

The process of biological desalination maintains a constant salt concentra-
tion necessary for the survival of living cells. The thin membranes sur-
rounding some plant and animal cells have the ability to selectively admit
or exclude certain chemicals. Reverse osmosis, one method of separating
fresh water from salt water, is used by mangrove tree roots; however this
is not the usual method of desalination in living cells. Animal tissues
cannot sustain the high pressures needed to filter water across dense mem-
branes. These tissues readily exchange matter between internal and exter-
nal media; salt may be pumped in or out, whichever the organism requires.
Biological desalination may be regarded as an active transport of salt a-
cross cell membranes. Ions and molecules are pumped against a chemical
concentration gradient, seemingly in defiance of the laws of diffusion.
Molecular structures located in the living membranes and powered by meta-
bolic energy serve as pumping mechanisms. The nature of this pump is un-
known; however, the process can be studied by applying nonequilibrium ther-
modynamics to couple diffusion with metabolic processes. Basic thermody-
namics, chemical processes, and membrane structure are discussed in the de-
velopment of a model for a biomechanical pump.

R202626X67A

R202631X67A   SHORT DISTANCE MEASUREMENT

A highly sensitive instrument for measuring extremely short distances has
been developed at the National Bureau of Standards. A field emission ul-
tramicrometer measures distances as small as a few hundred angstroms with-
out physically contacting the object being measured. Calculations indicate
distances of one-thousandth to one-millionth cm can be measured with a re-
producibility within 10 ppm. The field emission ultramicrometer is basi-
cally an arrangement of field emission electrodes in a vacuum chamber. The
electrodes are connected to a constant-current electrical circuit and a
precise voltmeter indicates a voltage directly related to the spacing be-
tween the electrodes. In most applications, a field emission tip serves as
1 electrode and the surface of the sample is the other electrode. Poten-
tial applications discussed include delineating surface profiles and con-
tours, measuring diameters of balls and holes, and a mechanical vibration
sensor, a strain gage, and a differential thermal expansion cell.

<div align="right">R202631X67A</div>

NUMERICAL INDEX

Volume 1, Number 3

INDEX-ABSTRACT WORKSHEET

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SHORT TITLE

ABSTRACT

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